Newborn Hearing Screening in Hawaii

Jean L. Johnson DrPH*, Nancy L. Kuntz MD**, Calvin C.J. Sia MD***, Karl R. White PhD****, Roma L. Johnson MA*****

In 1989, Surgeon General C. Everett Koop challenged parents, physicians, state agency staff, and researchers to work together to find better ways to identify young children with hearing impairments. He urged that by the year 2000 all children with significant hearing impairments be identified before 12 months of age[1,2] Today, Hawaii is screening more than 90% of its births and is on the threshold of achieving this Year 2000 Health Goal. Only a handful of other states, e.g., Rhode Island, Utah, Colorado, Iowa, and Wyoming, have made substantial strides toward this goal, and only Rhode Island has implemented a statewide program similar to Hawaii's.

This Year 2000 Goal was set because of the failure of the nation to improve the age of early identification of early loss, despite decades of efforts.[3] Prior to 1993, the average age of identification of a child with severe-to-profound hearing loss was approximately 2-1/2 years, with significant mild-moderate hearing loss not identified until after 5-6 years of age.[4,5] A 1987 study in Hawaii found that the average age of identification for severe-to-profound hearing loss ranged from 2.8 months to 4.4 years, depending on where the child lived and the family's health insurance coverage.[6]

Why Early Identification is Important

While the devastating effect of severe-to-profound hearing loss has long been recognized,[7,8] only recently have the negative consequences of mild-to-moderate bilateral or unilateral hearing loss become evident.[3] Emerging brain research on the critical importance of auditory competence during the first three years of life underscores the importance of identifying any hearing loss as early in life as possible to assure that the acquisition of communication skills is not delayed.[9-11] Obviously the greatest emotional and functional impact of hearing disability is on the newborn and the family.

Moreover, parents have been concerned over the delay in identifying their children's hearing loss. As reported in a 1995 study, few parents of hearing impaired children were satisfied with the age at which their child's impairment had been confirmed. More than three-fourths of the parents surveyed would have welcomed a neonatal hearing screening program.[12]

Not only does undiagnosed hearing loss in infants have negative consequences for the family, the community also suffers. An analysis for the United States Department of Education concluded that the cost for special education services in a self-contained classroom is approximately three times the cost of a regular classroom. If a child requires a residential program, the cost is approximately ten times more per year.[13] Identifying hearing disability before 12 months of age, providing the children with appropriate medical and audiological management, and enrolling them in early intervention programs, substantially reduces the need for extensive special education services.[14]

In recognition of the importance of the early detection of hearing loss, and with the increasing availability of reliable technology,[15-18] these and many other articles over the past two years, both in Europe and the United States, recommend implementation of universal newborn hearing screening.[8,19-21] That it is now both possible and feasible to lower the age of identification of hearing loss is now widely recognized.[22-25] Articles now address the importance of the issues of legal liability and quality assurance.[26]

Hawaii Begins Reaching for the Goal

With the support of the Hawaii Chapter of the American Academy of Pediatrics and the Hawaii Speech-Language-Hearing Association, legislation was introduced in 1990 to mandate universal newborn hearing screening in Hawaii. In May 1990, Governor Waihee signed Act 85 (HRS §321.361-363) into law in celebration of Better Speech and Hearing Month.[27]

The act assigns responsibility to the Department of Health (DOH) in four areas:

1) develop methodology for identification and intervention;
2) develop guidelines for screening, identification, diagnosis, and monitoring;
3) develop a plan to involve parents in the medical and educational follow-up and management of the hearing impairment; and
4) develop a plan for the collection of data and program evaluation.

Hawaii's legislation does not mandate a particular methodology or technology. The DOH has specifically elected not to adopt rules for the implementation of the program in order to enable the program

*Zero-to-Three Hawaii Project
**Family Health Services Division
***Carnegie Project
****National Center for Hearing Assessment & Management, Utah State University
*****Newborn Hearing Screening Program

to be responsive to any new technology or methodology consistent with the goal of early identification of hearing loss.

With the support of the Hawaii Chapter of the American Academy of Pediatrics and the Pediatric Committee of Kapiolani Medical Center for Women and Children (KMCWC), newborn hearing screening began in 1992, using otoacoustic emissions screening. Kaiser Medical Center began screening in April 1992, utilizing unilateral automated auditory brain stem (ABR) screening. Screening was expanded to Maui Memorial Hospital (MMH) in February 1993. The Queens Medical Center began screening in July 1993. Tripler Army Medical Center implemented screening in the Spring 1996.

Currently, all but one of the smaller birthing facilities have been providing universal newborn hearing screening. Kona Community Hospital is now the only hospital in the state not providing newborn hearing screening. Thus, hearing screening is now available to 96% of all newborns in the state. With the exception of Kaiser Medical Center, all hospitals use bilateral otoacoustic emissions as the method of screening.

Otoacoustic omissions (OAEs) are acoustic responses associated with the normal hearing process. OAEs are produced in the inner ear and can be measured with a low-noise microphone placed in the ear canal. These responses are commonly elicited by the use of brief acoustic stimuli such as clicks. Research has demonstrated the practicality of using OAEs to identify hearing loss in newborns.[3]

The use of this technology for newborn hearing screening has the following advantages: 1) simplicity: no advanced technical training is required for administration; 2) rapidity: detection of OAEs can be achieved in less than 5 minutes for both ears; 3) noninvasiveness: the acoustic probe is placed into the external ear canal using an impedance probe protector without support; 4) objectivity: a visual record of cochlear response is provided for future reference; and 5) sensitivity: this technique is sensitive to hearing loss down to 25 decibel HL.

As Table 1 shows, the percentage of children screened since the beginning of the program has been progressively increasing.

Table 1.—Percentage of Newborns Screened by Year in Hawaii's Newborn Hearing Screening Program

Year	Percentage
1992	19%
1993	44%
1994	55%
1995	65%
1996	79%
1997	95%

Operation of the Screening Program

Since its inception, the screening program has been an example of private-public partnership. The DOH provides seed money in the form of equipment, supplies, technical support, training, and (in the early years) personnel to do the screening. The DOH began with the larger hospitals, gradually transferring support to the smaller birthing centers as the larger hospitals could assume the cost of the program. As hospitals begin receiving revenues from billing for the services, each hospital gradually assumes the cost of direct screening operations. The data-tracking system is operated by the DOH. The DOH continues to provide training, technical support, and quality assurance.

Hospitals use a variety of personnel for screening. Larger facilities such as KMCWC, MMH, Queens, and Tripler use full-time, dedicated screeners. Smaller facilities rely on nursing staff (e.g., Wilcox Memorial Hospital) or volunteers (e.g., Hilo Community Hospital).

Infants are generally screened within the newborn nursery, or, if the nursery's noise-level is unacceptable, in an adjacent room. Best results are obtained after the first 24 hours following the birth. If an initial response is not obtained, several efforts are made to secure a response. If a response still cannot be secured, the infant is scheduled to return for a rescreen as soon as possible. If responses cannot be obtained during the second screening, the infant is referred for a diagnostic ABR evaluation.

Since newborn hearing screening is standard-practice-of-care in each hospital, parental permission is not required. Parents and pediatricians are informed whenever responses are not obtained from the newborn. For those newborns for whom screening cannot be completed prior to discharge, parents are notified that the child was not screened and parents are offered the opportunity to return for out-patient screening.

Intervention Services

A universal screening program is obviously only the first aspect of the system of care necessary to reduce the negative consequences of congenital hearing loss.[5,28] Whenever responses are not obtained during the second screening (anywhere in the state), a referral is made to the Newborn Hearing Screening Program for assistance in scheduling the ABR. The services provided to the child and family are tracked through a data management system.

If the diagnostic evaluation identifies the child as having a significant hearing loss, a referral is immediately made to the Hawaii Keiki Information Services System (H-KISS) for assignment of a care coordinator through the Zero-to-Three Hawaii Project. The care coordinator, working closely with the family and in collaboration with pediatrician or the child's medical home, arranges for appropriate intervention services. A significant hearing loss makes a child eligible for services under Part H of the Individuals with Disabilities Education Act (IDEA).

The care coordinator works with the family to assure that all the diagnostic and necessary medical services are obtained. Fitting of amplification at the earliest possible age is the highest priority. Additionally, all other services needed for the optimal habilitation of the child are made available. These services include auditory training, speech-language therapy, child development services, parent training and counseling, sign-language instruction, and other eligible services needed by the family. Every effort is made to provide the family with information and support for a full range of options for communication and early education.

Services continue until the child reaches the age of three. Transition planning occurs between the age of 2-1/2 and 3 years to determine the most appropriate services after the age of three. Many children at the age of three have been successfully transitioned into

Table 2.—Age of Identification and Amplification of Newborns in Hawaii

Birth Year	Average Age Identified	Average Age Aided
1987*	42 months	50 months
1991	17 months	19 months
1992	12 months	16 months
1993	6 months	11 months
1994	10 months	16 months
1995	6 months	12 months
1996	3 months	7 months

*For births for previous five years where complete information could be obtained.

community preschool programs with supportive services. Others become eligible for IDEA services through the Department of Education.

Results for Hawaii

The results for Hawaii unequivocally demonstrate that newborns can be effectively screened, with drastic reductions in the age of identification and the time of amplification. The data for the past decade are displayed in Table 2. The table shows that many of the children are being aided prior to six months of age. Unfortunately, speedy provision of amplification remains a problem, largely because of the policies of some third-party insurers. The expedited provision of amplification requires increased attention.

Exact cost estimates are elusive, but the range within the state is from $30-50 per child screened. These ranges are consistent with national averages. Hawaii's cost range compares well, being the least expensive per case identified of any newborn screening program. Table 3 compares the cost of identifying one child with significant permanent hearing loss with the cost of identifying children with hypothyroid, PKU, cystic fibrosis, and HGB. As the table shows, the cost per child for hearing screening is several times larger than tests for the other conditions, but the cost is several times less for each confirmed diagnosis.

Related Events

Increasing attention at the national level has focused on universal hearing screening since Hawaii passed its legislation. In March 1993, a Consensus Panel of the National Institutes of Health concluded that all infants should be screened for hearing impairment with a test that measures for otoacoustic emissions.[29] NIH also recommended that all infants with a significant hearing loss be identified by three months of age, with intervention beginning prior to six months of age.

Other organizations have urged stepped-up identification of hearing loss in children. In 1994, the American Academy of Pediatrics, along with four other professional organizations, drafted a joint position statement calling for the early detection of hearing loss.[30] Representative James Walsh (R-NY) introduced the Infant Hearing Screening/Hearing Loss Testing Act in the 104th Congress. The legislation would mandate hearing testing for all newborns, requiring private insurance companies and Medicaid to cover the cost of the screening. Hawaii was the first state to pass legislation; now Connecticut has become the fifth state in the nation to mandate

Table 3.—Comparative Cost of Identification of Various Conditions in Newborn Screening Programs (31)

	Sensorineural Hearing Loss	Hypothyroid	PKU	Cystic Fibrosis	HGB
Frequency per 100,00 births	564 (1) 376 (2)	25	7	50	13
Average age of diagnosis if unscreened (in months)	30	3 - 12	3 - 12	42	3 - 36
Cost of screen per child	$25	$3	$3	$3	$3
Cost per confirmed diagnosis	$4,440 (1) $6,650 (2)	$10,800	$40,500	$6,000	$23,100

(1) Unilateral
(2) Bilateral

newborn hearing screening.

Additionally, the Maternal and Child Health Bureau funded a grant in 1996 to encourage states to implement universal newborn hearing screening programs. The Centers for Disease Control, in collaboration with the Office of Special Education and Rehabilitative Services and the Maternal and Child Health Bureau, is funding a new study to explore various models of statewide tracking and data management for newborn hearing screening programs.

Case Studies

Three case studies from Hawaii demonstrate the critical importance of relying on objective, universal screening versus subjective pediatric and family surveillance for early identification.

Case 1

When a newborn was identified by the screening program and was undergoing diagnostic evaluation, the audiologist, observing the auditory behaviors and speech patterns of the infant's three-year-old sister, was alerted to the possibility of hearing loss in the sister. Both children were found to have a moderate-to-profound bilateral hearing loss. Neither the girl's parents nor her pediatrician had raised the possibility that she might have a hearing loss. The younger brother is now in preschool with age-appropriate communication skills. Sadly, the older sister, remains in a special education class with delayed receptive and expressive language skills.

In at least two other families, older siblings with hearing loss have been identified as a result of the referral of the newborn for diagnostic evaluation after the infants failed the hospital screening. In one family, two older siblings were identified with the same pattern of hearing loss as the newborn.

Case 2

This child, born at one of the birthing centers providing newborn hearing screening, was not screened prior to discharge. A letter from the hospital's audiologist informed the parents that screening was not done, but was available on an out-patient basis. A copy of the letter was sent to the child's pediatrician. The letter encouraged the

parents to bring the baby in for screening, but they chose not to do so. When this child was 2 1/2, the family began to suspect that the child might have a hearing loss. They consulted the pediatrician at the age of 2 years nine months. This child was found to have a bilateral severe-to-profound hearing loss with severely delayed speech and language development. Obviously the child would have benefited from early identification. The parent regretfully remembered vividly the earlier notification about the availability of the screening service.

Case 3

A child failed the initial hospital screening and was scheduled to return. Despite notification letters to the parents and pediatrician, the child was not brought in for the second screening. At the age of 11 months, the pediatrician became suspicious about the child's hearing and made a referral for a diagnostic audiological evaluation. The child was found to have a severe bilateral hearing loss.

Summary

Hawaii has been a pioneer and national leader in implementing universal newborn hearing screening. In fact, Hawaii is one of only two states (Rhode Island is the other) which have a statewide newborn hearing screening program in which 95% or more of all newborns are screened. Hawaii is the best example of a truly integrated system of services to provide effective intervention for all infants and toddlers who are identified as having a hearing loss.

The success of the newborn hearing screening program is measurable in two ways: 1) **all available information indicates that not a single infant with hearing loss has been missed by the screening process and not a single infant has been misdiagnosed as having a hearing loss**; and 2) many of the children identified with hearing loss by the newborn hearing screening program have transitioned out of the early intervention program with age-appropriate developmental and communication skills.

The success of Hawaii's program is a tribute to the enthusiastic support and collaboration of legislators, pediatricians, hospital staff, and DOH personnel.

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